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ASSESSMENT OF WATER QUALITY PARAMETERS: A REVIEW

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ABSTRACT

Drinking water is an important constituent for all types of living beings. Groundwater is one of the most valuable natural resources, which supports human health, economic development and ecological diversity. The various physico-chemical parameters such as color, Water temperature, alkalinity, acidity, hardness, pH, sulphate, chloride, DO, BOD, COD, EC, TDS, Calcium and Magnesium, Sulphate, Nitrate, Nitrogen as Ammonia, Nitrogen as Nitrate and Nitrogen as Nitrite used for testing of water quality are discussed and studied in this paper. The objective of study was to know the important water quality parameters for Drinking, Irrigation and Aquatic life i.e. multipurpose from surface water bodies as well as ground water. Various researchers explained their views about water quality parameters that are explained below. From this study it will seen that, all parameters are equally important. There is lot of parameter for drinking water quality parameter like world health organization (WHO), Indian Standard IS 12500:2012, Environmental Protection Agency (EPA), Environmental Quality Standards (EQA).

Some water analysis reports with physic-chemical parameters have been given for the exploring parameter study. Guidelines of different physic-chemical parameters also have been given for comparing the value of real water sample.

KEYWORD: Drinking water, water quality parameters, underground water

INTRODUCTION:

Water quality is a major environmental issue. Pollution from nonpoint sources is the single largest remaining source of water quality impairments in the United States. Agriculture is a major source of several nonpoint-source pollutants, including nutrients, sediment, pesticides, and salts. Envirmental no point pollution decreasing policies can be structure to induce producers to change their production bodes in ways that improve the environmental and related economic consequences of production. The information necessary to design economically efficient pollution control policies is almost always lacking. Instead, policies can be designed to achieve specific environmental or other similarly related goals at least cost, given transaction costs and any other political, legal, or informational constraints that may exist. This research paper outlines the economic character of 5 instruments that can be used to decreasing envirmental no point source pollution (economic incentives, standards, education, liability, and research) and discusses empirical research related to the use of these instruments. Water quality, nonpoint-source pollution, envirmental incentives, standards, education, liability, research, environmental ecological and policy.

Water quality refers to the chemically, physically, biologically, and radio logically characteristics of water. It is a measure of the methods of water relative to the apparatus of one or more biotic species and or to any human need or purpose. It is most tendons used by reference to a set of standards against which compliance, generally achieved through treatment of the water bodies, can be assessed. The most same standards useable to assess water quality relate to health of ecology systems, protect of human contact, and drinking water. These parameters for water quality are prediction by the intended use. Work in the area of water quality tends to be main point on water that is treated for human consumption, industrial use, or in the environment. Sub area changes, fertilizer selection from farms, storm water from streets, and other forms of diffuse pollution are now recognized as having serious environmental consequences. In more than fifty percent of estimated cases in which water quality goals are not achieved, diffuse pollution is cited as the main cause. This surveys the major problems and a challenge presented by this form of pollution, and offers a wide range of feasible, cost effective solutions for dealing with them. Water quality: prevention, identification, and management of degraded pollution covers aspects of diffuse pollution ranging from sources and sites to health and legal consequences. The research provides an integrated approach to water quality control and explain advanced pollution abatement methodologies, such as the use of wetlands. Sections on repercussions to the ecological include discussions of benefit analyses of abatement programs and the payments that support the programs.

MATERIAL AND METHODOLOGY:

Water column physicochemical parameters:

Water is formed by the covalent union of two hydrogen (H) atoms and one oxygen (O) atom. These atoms are joined in an unsymmetrical arrangement where the hydrogen end of the molecule has a slight positive charge and the oxygen end a slight negative charge. This arrangement of unbalanced electrical charges creates the dipolar characteristic that gives the molecule the remarkable ability to act as both an acid and a base and be a solvent for cations, anions, and some types of organic matter. This arrangement also allows water molecules to form hydrogen bonds with adjacent water molecules. These bonds are responsible for water's high viscosity, high cohesion and adhesion, high surface tension, high melting and boiling points, and the large temperature range through which it is a liquid. As water travels across the landscape, it interacts with its environment through a variety of chemical processes. In the process transports dissolved gases, positive ion and negative ion, amorphous organics, trace metals, and particulates. The most common positively charged ions, or cations, include calcium (Ca^{++}), magnesium (Mg^{++}),sodium (Na^{+}), potassium (K^{+}), and ammonium (NH_4^{+}). The most common anions, or negatively charged ions, include nitrate (NO_3-), sulfate (SO_4--), chloride (Cl-), and several different forms of phosphorus (P).

The physical characteristics of concern in river water are temperature, colour, turbidity, sediments, taste and odour. Because of its hydrogen bonds and molecular structure, water has an unusual trait—the density of its solid phase (ice) is lower than that of its liquid phase (water). Because of this trait, ice floats, pipes and plant tissues rupture when the water within them freezes and expands. The rates of chemical and metabolic reactions, viscosity and solubility, gas-diffusion rates, and the settling velocity of particles depend on temperature.

Pure water is colorless in thin layers and bluish green in thick layers. Particulates and insoluble compounds typically add color and reduce transparency. Consequently, the presence of light-dependent aquatic organisms can affect esthetic appeal and taste of water as well as the effectiveness of certain wastewater treatment processes. Turbidity is an optical property related to the scattering of light and clarity. It is typically controlled by the presence of suspended particles or organic compounds. Turbidity itself is not injurious to human health. Approximately 50 percent of the total incident light is scattered or transformed into heat within the first meter of water.

Sediment is a major water-quality concern because of its ability to transport harmful substances and its impacts on the cost of water treatment and the maintenance of water distribution systems. While sediment is derived during the natural weathering and sculpturing of the landscape, accelerated levels of erosion and sedimentation are associated with many anthropogenic activities. The general term sediment includes both organic and inorganic particles that are derived from the physical and chemical weathering of the landscape. Individual particles are eroded, transported, and deposited.

Aquatic organisms are usually grouped into those that obtain the carbon they need for biosynthesis from carbon dioxide (autographs) and use existing organic compounds as their carbon source (heterotrophy). Generally, autographs increase DO concentrations in water through photosynthesis, while heterotrophy's are responsible for breakdown and recycling of dead organic materials and decreased DO concentrations. Most microbial contaminants in water are caused by heterotrophy's that are transmitted to a water system via human and animal fecal matter. Most waterborne pathogenic microorganisms are bacteria or viruses that survive in sewage and septic leach ate. Bacterial pathogens are generated by both animal and human sources, while viral pathogens are usually only generated by human sources. Viruses that infect animals normally do not cause illness in humans. However, animal sources for some

viruses that effect humans are suspected, particularly viruses that infect the respiratory system like the sin hombre virus, Hantavirus, influenza virus, and Ebola virus. Common bacterial diseases spread by aquatic microorganisms include Legionnaire's disease, cholera, typhoid, and gastroenteritis. Waterborne viral diseases include polio, hepatitis, and forms of gastroenteritis. Waterborne parasitic diseases include amoebic dysentery, flukes, and giardiasis. Giardia spp. and Cryptosporidium spp. is parasitic protozoans that are transferred between a animals and humans via the fecal-oral route and are significant sources of gastrointestinal illness. They are common in surface water in back-country areas, including in many national forests and parks.

Table 1. Physicochemical parameter & there units

Serial No.	Physical parameter	Units
1	Water temperature	Degrees Celsius
2	pH	pH units
3	Dissolved oxygen	Milegram/liter
4	Biochemical oxygen demand	Miegram/liter
5	Chemical oxygen demand	Milegram/liter
6	Conductivity	µmhos/cm
7	Salinity	Parts per thousand
8	Secchi	Meters
9	Depth of collection	Meters
10	Depth of sample site	Meters
11	Air temperature	Degrees Celsius
12	Wind direction	Degrees
13	Wind velocity	Miles per hour
14	Cloud cover	Percent
15	Color	PCU
16	Turbidity	NTU
17	Total suspended solids	Milegram/liter
18	Total solids	Milegram/liter
19	Chlorophyll a	µg/l
20	Chlorophyll b	µg/l
21	Chlorophyll c	µg/l
22	Pheopigments	µg/l
23	Chlorophyll a corrected	µg/l
24	Chlorophyll a/ pheopigment ratio	µg/l
25	Total kjeldahl nitrogen as N	Milegram/liter
26	Nitrate + nitrite as N	Milegram/liter
27	Total phosphorus as P	Milegram/liter
30	Total orthophosphorus as P	Milegram/liter

Water Quality Related Problems in Public Health Environment & Agriculture:

The knowledge of water quality and its contents is very essential for judging its suitability for different purpose such as drinking, irrigation, industry, public health and environmental safety. There are various types of standards in view of the consumption of water like:

(a) **Drinking water standards:** Water is directly consumed by all human beings. There are certain national as well as international authorities, who have laid down various standards for domestic use of drinking water. For this purpose the main Indian agencies are like Indian Council of Medical Research (ICMR), Bureau of Indian Standards (BIS), and Ministry of Works and Housing (MWH) where as international agency is named as World Health Organization (WHO). Some important drinking water standards are as follows:

Table2. Drinking Water Standards

Characteristics of physicochemical	According to WHO highest desirable	According to WHO maximum permissible	Ministry of works & housing (1975) Acceptable	Ministry of works & housing Causes of rejection
Turbidity (JTU)	5.0	25.0	2.5	10.0
Color (Pt-scale)	5.0	50.0	5.0	25.0
Taste & odour	Nothing	Disagreeable	Unobjectionable	Unobjectionable
pH	7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.2
Total solids	500	1500	500	1500
Total hardness	100	500	200	600
Chlorides	200	600	200	1000
Sulphates	200	400	200	400
Fluorides	1.0	1.5	1.0	1.5
Nitrates	45	45	45	45
Calcium	75	200	75	200
Magnesium	30	150	30	150
Iron	0.1	1.0	0.1	1.0
Manganese	0.05	0.5	0.05	0.5
Copper	0.05	1.0	0.05	1.5
Zinc	5.0	15.0	5.0	15.0
Phenolic compounds	0.001	0.002	0.001	0.002
Detergents, anionic	0.2	1.0	0.2	1.0
Mineral oil	0.01	0.30	0.01	0.30
Arsenic	0.05	0.05	0.05	0.05
Chromium	-	0.01	0.05	0.05
Cyanide	-	0.05	0.05	0.05
Lead	-	0.10	0.10	0.10
Selenium	-	0.01	0.01	0.01
Cadmium	-	0.01	0.01	0.01
Mercury	-	0.001	0.001	0.001
PCBs(µg/l)	-	0.2	0.2	0.2
Gross α-activity (PCi/l)	-	3.0	3.0	3.0
Gross β-activity (PCi/l)	-	30.0	30.0	30.0

(b) **Bacteriological standards:** Bacteriological standards in water are standardized by WHO and Ministry of Works and Housing, both such as:

By WHO

(A) **Water entering distribution system:** Coliform bacteria Count in any sample of hundred ml should be zero.

(B) **Water in distribution system:** All samples taken from the distribution system including consumer's premises should be free from coliform organisms. Since in practice it is not always possible, even then following standards can be followed:

(i) Throughout the year, 95% of the samples examined should not have any coliform organisms.

(ii) E.coli count in any 100ml sample should be 0.

(iii) Coliform organisms not more than 10/100ml should be given present in any reagent sample.

(iv) Coliform organisms should not be detectable in 100ml of any two consecutive samples.

Ministry of works & housing

(A) **Water entering distribution system:** Coliform count in any sample of 100ml should be 0.

(B) **Water in distribution system:** Shall be satisfied by all the three criteria given below:

(i) E-coli count in 100ml of any sample should be 0.

(ii) Coliform organisms not more than 10/100 ml should be present in any sample.

(iii) Coliform organisms should not be detectable in 100ml of any two consecutive samples of more than 50% of the samples collected for the year.

(C) **Irrigation standards:** The quality of water for irrigation purpose should be up to the mark. The major parameters of concern are:

(a) Salinity: The salinity of water should be less for irrigation purpose, because salts in water reduce water should be less for irrigation purpose, because salts in water is denoted by dissolved solids and conductivity.

(b) Water infiltration rate: High sodium and low calcium content of water reduces the rate at which irrigation water enters soil to such an extent that sufficient water can not be infiltrated to supply the crop adequately from one irrigation to the next.

(c) Specific ion toxicity: The presence of some ions such as sodium, boron or chloride in irrigation water accumulates in crops. It causes crop damage and reduces yield, if the ion concentration is considerably high.

(d) Miscellaneous: When nutrients in water are in excess, it causes reduction in yield. These nutrients deposit on fruits or foliage.

(e) Sodium concentration: Sodium in water can be denoted by- Sodium , Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC). These parameters in water can be calculated by the following formulae and the values of individual constituents are taken in mEq./L.

Percent sodium=$Na^{+}/Ca^{2+}+Mg^{2+}+K^{+}+Na^{+}*100$

(d) Stream standards: For each typical use of water(like irrigation, drinking , industry, power generation, recreations, etc.), water quality criteria are established. Any water body can be designed for some particular best use which can be termed as designated best use.

On the basis of the designated best use of water, water resources can be classified and zoned in different categories. For fresh water, the water quality criteria are classified by Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCB). The above named boards have adopted a scheme of classification and zoning of water bodies, which is given below:

Table 3. Classification and zoning of water bodies (CPCB 1979)

Designated best use	Nomenclature for the class of water
Fresh water	
Drinking water source without conventional treatment but after disinfection.	Class A
Out-door bathing	Class B
Drinking water source with conventional treatment followed by disinfection	Class C
Propagation of wildlife, fisheries	Class D
Irrigation, industrial cooling and controlled waste disposal	Class E
Sea waters (Including Estuaries & coastal waters)	
Salts pans, shell fishing, contact sport	SW I
Commercial fishing, non-contact recreation	SW II
Industrial cooling	SW III
Harbor	SW IV
Navigation, controlled waste disposal	SW V

In above data, there should be no visible discharge of domestic and industrial wastes into class A waters. In case of class B & C, the discharges shall be regulated so as to ensure the maintenance of the stream standards.

Table 4. Water quality criteria for fresh water classification (CPCB 1979)

Classes	Criteria
Class A	Dissolved oxygen (minimum 6 mg/l), BOD (Maximum 2 mg/l), MPN of coliforms per 100ml (maximum 50), pH (6.5-8.5)
Class B	Dissolved oxygen (minimum 5 mg/l), BOD (Maximum 3 mg/l), MPN of coliforms per 100ml (maximum 500), pH (6.5-8.5)
Class C	Dissolved oxygen (minimum 4 mg/l), BOD (Maximum 3 mg/l), MPN of coliforms per 100ml (maximum 5000), pH (6.0-9.0)
Class D	Dissolved oxygen (minimum 4 mg/l), pH (6.5-8.5), Free ammonia as N (maximum 1.2mg/l)
Class E	pH(6.0-8.5), Electrical Conductivity (maxmimum mS/cm 2250), Sodium absorption ratio. SAR (maximum 2mg/l)

(e) Effluent standards: The standards of effluent are related to the quality of waste waters, which are originated from industry, community and agriculture. Some important effluent standards in land surface water, public sewers, land for irrigation and marine coastal area were fixed by Central Pollution Control Board in 1995. There data are given as follows:

Table 5. General standards for discharge of effluents (CPCB 1995)

S. no.	Parameter	Inland surface water	Public sewers	Land for irrigation	Marine coastal area
1	Colour & odour Suspended solid, mg/l max	100	600	200	(a) For process waste water-100 (b) For cooling water effluent 10% above total suspended matter of influent cooling water
2	Particle size of suspended solids	Shall pass 850 micron IS sieve	-	-	(a) Floatable solids, Max 3mm (b) Settable solids max 850 microns
3	Dissolved solids (inorganic), mg/l max	2100	2100	2100	-
4	pH value	5.5-9.0	5.5-9.0	5.5-9.0	5.5-9.0
5	Temperature ºC, max	Shall not exceed 40 in any section of the stream within 15 meters downstream from the effluent outlet	45 at the point of discharge	-	45 at the point of discharge
6	Oil & grease mg/l max	10	20	10	20
7	Total residual chlorine mg/l max	1.0	-	-	1.0
8	Residual sodium carbonate, mg/l max	-	-	5.0	-
9	Cyanide mg/l max	0.2	0.2	0.2	0.2
10	Chloride mg/l max	1000	1000	600	-
11	Fluoride mg/l max	2.0	15	-	15
12	Dissolved phosphate mg/l max	5.0	-	-	-
13	Sulphate mg/l max	1000	1000	1000	-
14	Sulphide mg/l	2.0	-	-	5.0
15	Pesticides	Absent	Absent	Absent	Absent
16	Phenolic compounds mg/l max	1.0	5.0	-	5.0
17	Radioactive materials α emitters µC/ml, max	10^{-7}	10^{-7}	10^{-8}	10^{-7}
18	αEmitters µC/ml, max	10^{-6}	10^{-6}	10^{-7}	10^{-6}
19	Percent Na	-	60	60	-
20	Ammonical nitrogen mg/l	50	50	-	50
21	Total Kjeldahal (nitrogen) mg/l max	100	-	-	100
22	Free ammonia mg/l max	5.0	-	-	5.0
23	Biochemical oxygen demand(5 days at 20ºC max)	30	350	100	100

S. no.	Parameter	Inland surface water	Public sewers	Land for irrigation	Marine coastal area
24	Chemical oxygen demand mg/l max	250	-	-	250
25	Arsenic mg/l max	0.2	0.2	0.2	0.2
26	Mercury mg/l max	0.01	0.01	-	0.01
27	Lead mg/l max	0.1	1.0	-	1.0
28	Cadmium mg/l max	2.0	1.0	-	2.0
30	Hexavalent chromium mg/l max	0.1	2.0	-	1.0
31	Total chromium mg/l	2.0	2.0	-	2.0
32	Copper mg/l max	3.0	3.0	-	3.0
33	Zinc mg/l max	5.0	15	-	15
34	Selenium mg/l max	0.05	0.05	-	0.05
35	Nickel mg/l max	3.0	3.0	-	5.0
36	Boron mg/l max	2.0	2.0	2.0	-

Table 6. Summary of water quality induces development on a national level

Index	Objective	Method	Author
The scatter score	Water quality	Assesses increases or decreases in parameters over time & space	Kim & Cardone (2005)
The well-being of nations	Human & ecosystem	Assesses human indices against ecosystem indices	Prescott & Allen (2001)
Environmental performance	Environmental health & ecosystem vitality	Uses a proximity-to-target measure for sixteen indices categorized into six policy objectives	Levy et al. (2006)
River water quality	River health	Uses multiplicative aggregate function of standardized scores for a number of water quality parameters	Liou et al. (2004)
Overall index of pollution	River health	Assessment & classification of a number of water quality parameters by comparing observations against Indian standards & other accepted guidelines for example WHO	Sargaonkar & Deshpande (2003)
Chemical water quality	Lake basin	Assesses a number of water quality parameters by standardizing each observation to the maximum concentration for each parameters	Tsegaye et al. (2006)
Water quality for freshwater life	Inland water	Assesses quality of water against guidelines for freshwater life	CCME (2001)

RESULT AND DISCUSSION:

Water Quality in some Indian River. Pollution of the Ganges, the largest river in India, poses significant threats to human health and the larger environment. Severely pollution with human waste and industrial waste, the river provides water to about forty percent of India's population across 11 states, serving an estimated population of 500 million people or more, more than any other river in the world. In 1909 the waters of the Yamuna were distinguishable as clear blue, as compared to the silt-laden yellow of the Ganges. However, due to high density population growth and rapid industrialisation today Yamuna is one of the most polluted rivers in the world, especially around New Delhi, the capital of India, which dumps about 58% of its waste into the river. A recent study shows that there is 100% urban metabolism of River Yamuna as it passes through the National Capital Territory (NCT) of Delhi. New Delhi generates 1,900 million litres (500,000,000 US gal) per day (MLD) of sewage. Though many attempts have been made to process it, the efforts have proven futile. The Gomti River is pollution at all points of its course through the 940-kilometre stretch of alluvial plains in Uttar Pradesh. The major sources of pollution are industrial waste and effluentfrom sugar factories and distilleries and residential wastewater and sewage. The mutha in 2010, areas all round the river experienced flash floods due to high levels of pollution and garbage dumped into the river. The College of Engineering, Pune (CoEP) holds an annual boating festival at the river near its premises. In 2012, it was found that the river was not navigable from Khadki to CoEP because the Maharashtra Natural Gas Limited had obstructed the flow of the river by constructing a mud path to lay a pipeline. The Mithi river has been pollution by dumping of raw sewage, industrial waste and municipal waste into the river. Besides this, illegal activities like washing the vessels, animals and oily drums, discharge of not authorized hazardous waste are also carried out along the course of this river. Cattle sheds in some areas contribute animal waste. Barrel cleaners, scrap dealers and others dump sludge oil, effluent and garbage in the river. The organiaum waste, sludge and garbage dumping has reduced the carrying capacity of the river. The water with mixture of sewage and industrial waste is a threat to marine life. The river bed is full of sludge, garbage and vegetation growth like water hyacinth in many parts. The city of Mumbai earned the epithet – 'Cottonopolis of India' due to its vibrant cotton textile mills. The mills over the years have utilized water from this river and dumped their waste into it leading to the present polluted state of the river.

Major River Basins in Chhattisgarh State:

The major rivers flowing in Chhattisgarh state are given in table 3. The Mahanadi river and its tributaries Seonath, Hasdeo, Mand and Arpa drain part of Raipur, Durg, Rajnandgaon, Bilaspur, Raigarh and Surguja districts. The Indravati river is a tributary to Godavari river and drains the districts of Kanker, Baster and Dantewada. Most of the river are perennial in nature. The drainage patterns in the state are dendritic, parallel, angular and radial types. Son is the tributary of Ganga river and drains parts of Sarguja and Koriya districts.

Table 7. Shows the Drainage existing in the State

S.No.	Major Rivers	Tributaries	Districts
1	Ganga 18407 Sq.Km.	Son	Surguja, Koriya, Jashpur & Bilaspur
2	Mahanadi 75858 Sq.Km.	Ib, Hasdeo, Seonath, Tel, Mand	Raipur, Mahasamund, Dhamtari and parts of Durg, Rajnandgaon, Kawardha, Korba, Kanker, Bastar, Surguja, Raigarh & Bilaspur
3	Godavari 38694 Sq.Km.	Indravati, Sabari Wain ganga	Parts of Durg, Bastar, Rajnandgaon, Kanker & Dantewada
4	Narmada 744 Sq.Km.	Narmada	Parts of Rajnandgaon, Bilaspur, & kawardha
5	Bramhani 1394 Sq.Km.	Sankh	Parts of Jashpur

Government of Chhattisgarh Water Resources Department:

Table 8. Description of Chhattisgarh water area

Description	India	Chhattisgarh	Percentage
Surface water	18,69,000 MCM	48,296 MCM	3.20
Ground water	4,35,420 MCM	14,548 MCM	3.17
Geographical area	32,68,090 Sq.Km	135,097 Sq.Km	4.13
Population	1030.0 Million	20.8 Million	2.00

Table 9. Comparison of water quality with drinking standards (Indian & WHO)

Serial no.	Parameters	ISI	WHO
1	pH	6.5-8.5	7.0-8.0
2	Sp.conductivity (mS/cm at 25°C)	-	-
3	Total dissolved solids	500	1000
4	Total hardness as $CaCO_3$ (mg/l)	300	-
5	Bicarbonate (mg/l)	-	-
6	Chloride (mg/l)	250	250
7	Sulphate (mg/l)	200	250

Serial no.	Parameters	ISI	WHO
8	Phosphate (mg/l)	-	-
9	Nitrate (mg/l)	45	50
10	Fluoride (mg/l)	1	-
11	Calcium (mg/l)	75	75
12	Magnesium (mg/l)	30	30
13	Sodium (mg/l)	-	200
14	Potassium (mg/l)	-	-
15	Silicate (mg/l)	-	-

CONCLUSION:

This paper is show about all water quality parameter and show the India and Chhattisgarh what will be improved for the water quality. This work for the fames rivers quality and water is directly consumed by all human beings. There are certain national as well as international authorities, who have laid down various standards for domestic use of drinking water. They are also informing the standards of effluent are related to the quality of waste waters, which are originated from industry, community and agriculture.

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